

Bolometer Array Technology Development at NIST

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We report on the development of detector, readout and on-chip micro-refrigerator technologies at NIST for large-format bolometer arrays with performance appropriate for missions including SAFIR. We manufacture both superconducting transition-edge sensor (TES) bolometers and normal-insulator-superconductor (NIS) bolometers. TES bolometer arrays include SCUBA-2, which will have more than 10,000 pixels. We are also developing NIS bolometers for low noise-equivalent power (NEP) applications. Large arrays of low-temperature detectors can be read out with cryogenically multiplexed SQUID amplifiers. At low frequencies, we use time-division multiplexers in which SQUIDs are turned on one at a time to sequentially read out large arrays of detectors. This mature technology is being used in arrays as large as 10,000 pixels (the SCUBA-2 instrument). We are also developing multiplexers based on ultra-low-power SQUID amplifiers frequency-division multiplexed at microwave frequencies. Microwave SQUID multiplexers may make it possible to read out many thousands of bolometers in a single HEMT amplifier channel. Finally, we present recent results using on-chip NIS micro-refrigerators. These integrated micro-refrigerators make it possible to operate detectors at temperatures well below 240 mK from He-3 cooling stages. It may also be possible to operate detectors at temperatures well below 40 mK from adiabatic demagnetization refrigerators. These temperatures were previously not available from an orbital platform. Operation at these temperatures may be useful in ultra-low-NEP applications (such as SAFIR spectrometers).